APPLICATION NOTE

POWER AND CONTROL SOLUTIONS FOR MIXERS AND BLENDERS

Pharmaceutical Manufacturing (UL)

Pharmaceutical manufacturing is a cornerstone of medicine, playing a critical role in producing innovative medications that enhance public health.

As the demand for medications increases, pharmaceutical equipment manufacturers need reliable, precise, and efficient electrical components. ABB's control and protection solutions help to ensure performance when it is needed the most.

What is mixing and blending?

Mixing and blending are essential to pharmaceutical manufacturing as they are used to combine ingredients into uniform and stable mixtures. While the two can sometimes be used interchangeably, mixers apply more force to integrate substances, whereas blenders combine them gently depending on formulation needs. Both types of equipment play a crucial role in ensuring consistency and uniformity across liquid, semi-solid, and solid pharmaceutical products. By maintaining stable mixtures, mixers and blenders help ensure reliable drug composition and quality.

Why is power and control important for mixing and blending equipment?

Power and control are essential for mixers and blenders because they regulate the energy and precision needed to achieve uniform mixtures. Power drives the mechanical motion required for effective blending, while control systems manage variables like speed, temperature, and timing to suit different material types. Together, they ensure consistent, high-quality outputs across various pharmaceutical formulations.

Main benefits

Continuous operation

Avoid operational disruptions and downtime with ABB circuit breakers. Equipped with advanced trip units, our breakers identify voltage irregularities and protect your production system.

Energy-efficient system

Our AF contactor coil technology boosts control panel energy-efficiency, which means less dissipated heat, reduced operating costs, and better equipment performance for your pharmaceutical processes.

Compact and easy to install

Save space, reduce assembly time, and experience greater design flexibility with our narrow designs in circuit breakers, contactors, and overload relays.

Safety and protection

Our product specifications help to enhance safety and reduce hazards by using surge protective devices and monitoring relays to help provide added equipment protection.

Pharmaceutical manufacturing

Process overview

Pharmaceutical manufacturing is a precision-driven process that transforms raw materials, active pharmaceutical ingredients (APIs) and excipients, into safe, effective, and consistent dosage forms. These forms include tablets, capsules, liquids, creams, inhaled formulations, and injectables, each requiring tailored handling and formulation techniques to meet strict quality and regulatory standards.

The following illustration outlines the core stages commonly involved in pharmaceutical manufacturing, beginning with raw material preparation and concluding with final product packaging.

Process	Steps	Description
Ingredient preparation	Weighing and dispensing	APIs and excipients are weighed in a controlled environment.
Ingredient processing	Granulation	Weighed ingredients are converted from powders to granules through wet or dry granulation.
	Drying	Moisture is removed from the product.
	Milling and sieving	Particles are further reduced to ensure uniformity and flow.
	Mixing and blending	The ingredients are mixed or blended to form a homogeneous mixture.
Product formation and finishing	Tablet compression or filling	The mixture is compressed into tablets or inserted into capsules.
	Tablet coating	A coating is applied to the tablet for protection, taste masking, and/or controlled release.
	Finishing and printing	The product is polished to enhance appearance and remove residues. Branding, identification marks, and dosing information added to final product.
Packaging	Primary and secondary packaging	Finished product is placed into packaging that directly contacts the product, such as blisters, bottles, or pouches. It is then enclosed in secondary packaging, such as cartons, along with labels and inserts.

Ingredient Preparation

1 Weighing and Dispensing

Ingredient Processing

2 Granulation

3 Drying

4 Milling & Sieving

5 Mixing & Blending

Product Formation and Finishing

6 Product Formation

7 Coating and Printing

Packaging

8 Primary Packaging

9 Secondary Packaging

10 Gas Cabinets

11 Vacuum Pump System

12 HVAC Room

13 LV/MV Distribution

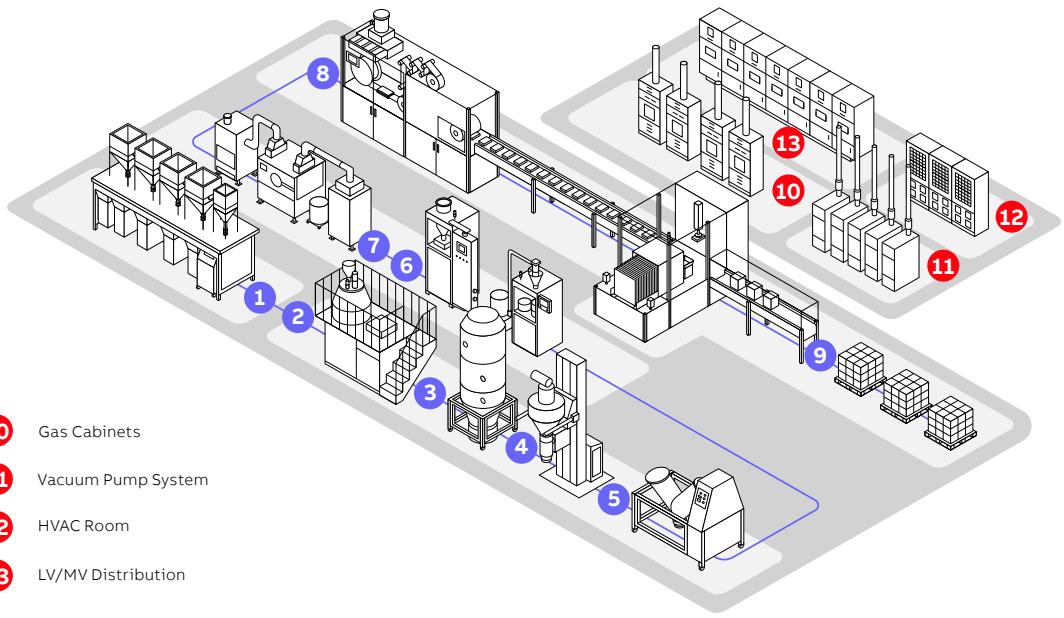


Figure 1: Layout of a generic pharmaceutical manufacturing process

Note: This diagram provides a simplified overview of pharmaceutical manufacturing and does not represent all processes or product types.

Mixing and blending

Process overview and types (1)

Pharmaceutical mixers and blenders are used to create a homogenous mixture from two or more substances. These substances consist of active pharmaceutical ingredients (APIs) and excipients, or inactive substances, that aid in processing or stabilizing APIs. Precision is critical in pharmaceutical manufacturing. As a result, mixers and blenders can be customized to specific batch sizes or formulations while also controlling temperature and speed during the process to ensure quality output.

By minimizing separation and maintaining uniformity, these mixers and blenders help guarantee that every tablet, capsule, or dose consistently delivers the intended amount of medication while meeting strict regulatory standards.

Objectives:

- Create a uniform composition
- Promote reactions to occur between the substances, when applicable
- Reduce risk of segregation or stratification of ingredients
- Ensure each dose has the correct amount of each substance
- Control temperature and moisture during processing
- Protect shear- or heat-sensitive materials from degradation

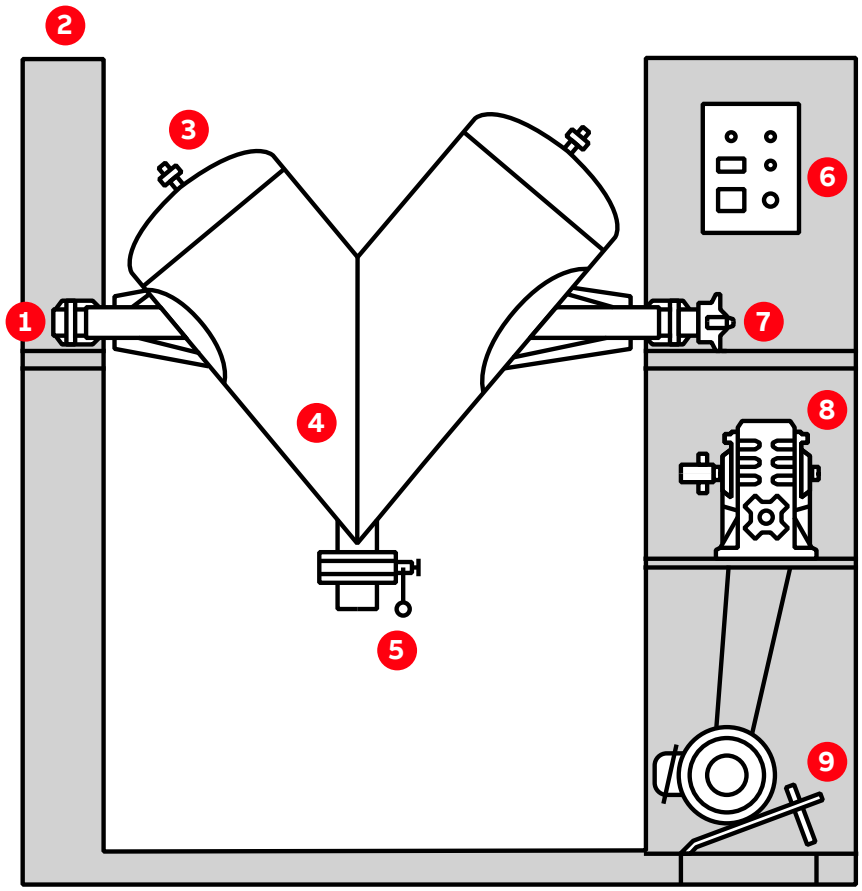
Types of pharmaceutical mixers and blenders (2):

Type	Usage	Function
High shear mixer	Ideal for emulsifications, dissolving solids in liquids, and fine suspensions in pharmaceutical products	Generates intense shear forces using rotor to effectively mix materials with different viscosities and densities
Ribbon blender	Efficient blending of dry powders, granules, and paste-like materials in bulk batches	Uses helical ribbon agitators within a U-shaped trough that move materials to achieve homogenous mixing
Planetary mixer	Mixing high-viscosity products like creams, gels, and other semi-solid formulations with uniform consistency	A central agitator rotates in a planetary motion within a stationary bowl, allowing for thorough distribution without material clumping
Fluidized zone mixer	Gentle blending and granulation of delicate or heat-sensitive powders, commonly used for coating	Creates a fluidized zone where particles achieve a uniform state, ensuring effective mixing without damaging the product
Double cone blender	Used for mixing dry powder and granules homogeneously, useful in mixing small batches of high-value ingredients	Utilizes two connected cone-shaped chambers that rotate together, providing uniform blending through tumbling without any shear or heat
V-blender	Gentle blender, primarily used for bending dry powders and granular materials	V-Shape design allows materials to flow gently to ensure uniform mixing without shear
Homogenizers	Critical for suspensions, injectables, and other emulsions	Reduces particle sizes and distributes them uniformly throughout the solution ensuring uniformity
Vacuum mixers	Commonly used for pastes, creams, and other semi-solid formulations	Removes air bubbles and prevents oxidation using a sealing mechanism to create and maintain the vacuum

Blender components

Mixers and blenders play a key role in pharmaceutical manufacturing, where APIs and excipients are combined to achieve a uniform mixture. Once the mixer is engaged, precise motion and controlled design ensure consistent distribution, supporting product quality and compliance with industry standards. Equally critical is the dependable power and protection that keep this process running reliably, safeguarding equipment and protecting product integrity. Together, advanced mixing technology and robust electrical infrastructure enable safe, efficient, and scalable pharmaceutical production.

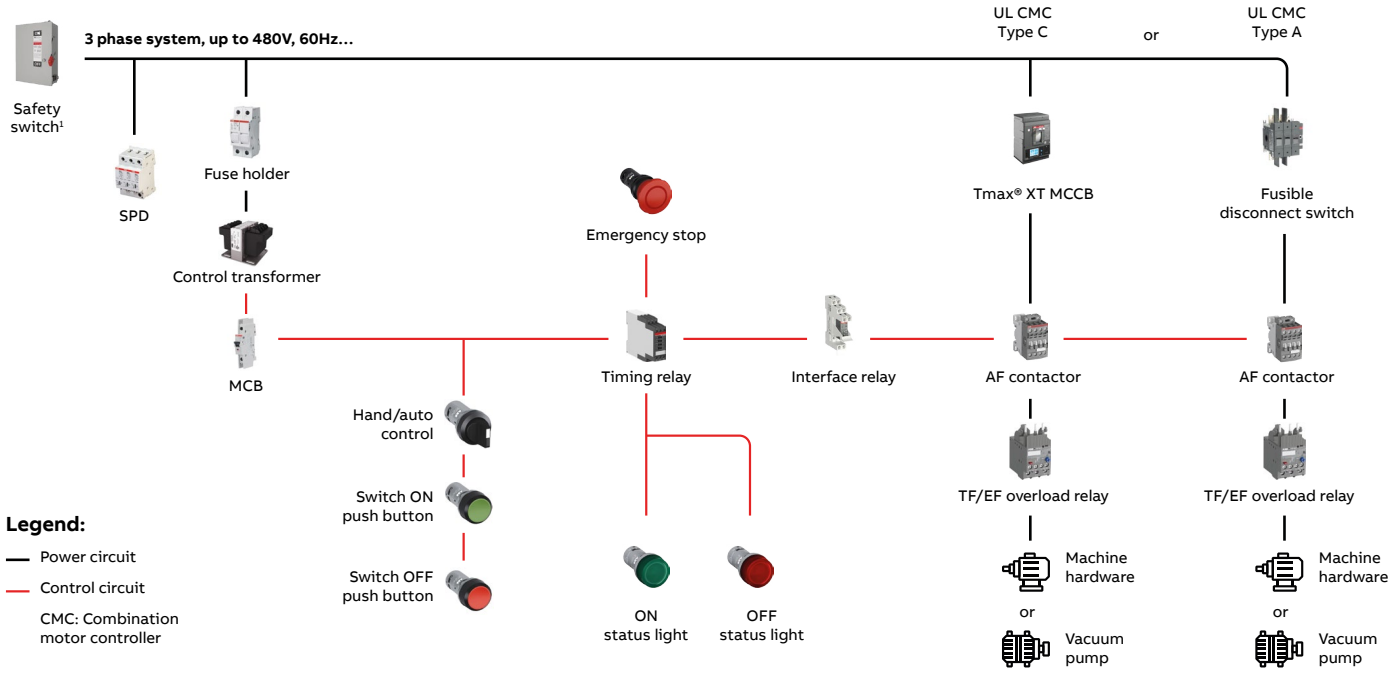
While there are various types of mixers and blenders used in pharmaceutical manufacturing, the illustration below highlights the primary components of a V-blender.



1. **Cylinder shaft**
   Connects and supports cylinder rotation
2. **Machine frame**
   Supports blender structure
3. **Feed inlet**
   Opening for loading materials into mixer
4. **Mixing cylinder**
   V-shaped vessel where materials are blended
5. **Feed outlet**
   Release for blended material
6. **Control screen**
   HMI that allows the operator to control and monitor the machine
7. **Coupling**
   Transmits motion from gearbox to shaft
8. **Gearbox**
   Gear reducer for speed and torque regulation
9. **Motor**
   Powers rotation of the blender cylinder

Figure 2: V-blender components and functions (3)

Power and control solutions for mixers and blenders



Note: This configuration is for a generic system and is not representative of existing manufacturers.
¹ Use the fusible version to meet NEC code requirements.

Main components and functions

Primary functional requirements

- Fusible switches, circuit breakers, and surge protective devices, to prevent equipment damage or fires
- Safety switches for lock out tag out (LOTO) procedures to protect service personnel and emergency stops to protect machine users.

Secondary optional requirements

- Pilot devices to give the operator a visual indication of machine status.

Power and control components and functionalities

Application	Electrical components	Functional description
Power circuit	Safety switch	Isolation, overload and short circuit protection
Power circuit	Surge protective device	Prevent damage from electrical surge
Power circuit	Fuse holder	Short circuit protection
Power circuit/Motor load	Circuit breaker	Isolation, overload and short circuit protection
Power circuit/Motor load	Fusible switch	Isolation, overload and short circuit protection
Motor load	AF contactor	Remote isolation and control
Motor load	TF/EF overload relay	Thermal and electronic overload protection
Control circuit	Miniature circuit breaker	Overload and short circuit protection
Control circuit	Control transformer	Reduces voltages from higher to lower
Control circuit	Interface relay	Isolates, connects, and ensures compatibility between components
Control circuit	Time relays	Enables timed operations for process control
Control circuit	Pilot devices	Provide visual status and machine control

Product offering

Tmax XT molded case circuit breakers

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AF contactors

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Safety switches

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Fusible disconnect switches

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Electronic overload relays

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WEB PAGE

Thermal overload relays

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Fuse holders

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Surge protective devices

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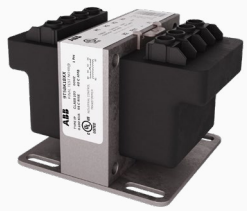
Control transformers



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Miniature circuit breakers

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Timing relay

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Definite purpose contactors

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B series mini contactors

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M series mini contactors

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Interface relays and optocouplers

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Assorted pilot devices

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(2) “8 Types of Mixers Used in the Pharmaceutical Industry,” MXD Process, Feb. 12, 2024. [Online]. Available: https://www.mxdprocess.com/blog/8-types-of-mixers-used-in-the-pharmaceutical-industry [Accessed: Oct. 3, 2025].

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